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Improving reading experience by integrating the Semantic Web in eBooks

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Preface: Meet the Scott family

Let's meet the Scott family a few years from now. This modern, middle class family lives a little outside of Boston. They all have their separate hobbies, but the one thing that connects them all, is their enormous love for books. Recently, they discovered e-reading and its possibilities.

Peter Scott is the father of the family. He is 45 years old, and owns a small consulting company in the centre of the city. He drives there every day in his brand new company car. In his spare time, Peter loves to go cycling. He collects magazines and technical manuals about bikes, so he can keep up with the latest evolutions. He is also a real multimedia gadget addict. He always has the latest smartphone, tablet and laptop for personal and professional use. He allows his family to use his tablet, but makes sure that everyone has their own login credentials.

Peter's wife Isabel is a 42 year old schoolteacher, employed in an elementary school a good few miles away. Every day, it takes a 30 minute train ride to get there. Isabel has flexible hours, so she takes care of most of the housekeeping, shopping and cooking. From time to time, she likes to look for recipes in cookbooks. When all work is done for the day, Isabel likes to read romance novels. She uses multimedia devices, but only if they make her life easier. She only owns an e-reader, which she got for her birthday. When she needs a computer, she just uses the family desktop in the living room.

Isabel and Peter have a son Marc, and a daughter Emma. Marc is 17 and is about to graduate from high school. He spends most of his time studying physics and math. Marc is a big comic book fan, so reading comics is usually how he fills his breaks. He has his own comic book club with some of his friends. Marc suffers from a slight eye disorder, i.e., Daltonism, which can sometimes disturb his reading experience. He has his own laptop for using the internet or playing games. He sometimes uses his father's tablet when he is not at his desk.

Marc's sister Emma is 10 years old. She is in her last year of elementary school. Emma is lactose intolerant, giving her special needs in food, and slightly dyslectic. Emma has a lot of hobbies. She goes horse riding every week and takes ballet classes. She also loves to read picture books with pictures of horses or ballet dancers. On her father's tablet, she has a subscription for an online bookstore, allowing her to download educational children's books.

In this paper, we discuss how the integration of semantic technology into e-books affects the life of the Scott family. In addition, we give a number of examples that illustrate how ontology reasoning, rule-based reasoning and following links can improve the reading experience of each family member.

Chapter 1: The family discovers personalized reading

It's six o'clock and Peter decides to drive home from work. He recently bought a new e-book, that he started reading on his tablet the day before. Before driving off, his on-board computer synchronises with his tablet via Bluetooth, and loads the ePub3 file of his new book. The book is annotated in RDFa with metadata, described in the audiobook annotations ontology. Every element in the book is linked with a corresponding audio resource. His board computer can understand these semantic annotations, and uses them to automatically turn Peter's book into an audio book. The book starts playing from where he left off in the sofa yesterday night, and brightens up his car ride.

Meanwhile back at home, Isabel started preparing dinner. She takes her e-reader to open up a good eCookbook. The content of the book is linked to personal data of the family. This sorts the book's index according to each family member's food preferences. Because of Emma's lactose intolerance, recipes are automatically altered to fit her nutritional needs. To ensure variety and balance in her family's food, Isabel lets the book suggest recipes based on past meals. This way, she can add missing nutritions today.

While waiting for dinner, Emma is finishing her math homework. She uses the family computer to read her textbooks. The content and language of the book are automatically tailored to her age, reading level, math level and her dyslexia. After each chapter, training exercises are automatically generated. Based on her answers, the follow-up questions are adjusted to her performance. This way, she gets more training in her weaker subjects. Since she is also taking Spanish lessons, the textbook uses machine translation to switch the book to Spanish on-the-fly. When Emma has trouble reading a Spanish word, she simply clicks the word to hear the correct pronunciation.

Meanwhile, Marc wants to read a comic book on his father's tablet. When he opens the book, the colors are adjusted to his color blindness. When the book detects Daltonism in Marc's personal profile data, it downloads the mapping description of the condition as a set of rules. The embedded reasoner modifies the SVG data in the ePub file by executing the rules.

Chapter 2: The family discovers enriched book content

After dinner, Marc decides to study some physics. He opens a textbook on the tablet and starts reading. When he has trouble understanding a word, he taps on it. The chosen concept is

linked to DBpedia, containing Wikipedia content, in the Linked Open Data cloud. The reading application retrieves helpful data (definitions, synonyms, pictures, examples) from the external source, generates an explanation about this topic and inserts it beneath the paragraph that Marc was reading. Despite the extra information, Marc did not completely understand one of the experiments. He taps an image showing the experiment, making the book automatically retrieve extra audiovisual material, explaining the experiment in several ways.

Peter spends a relaxing evening in the couch. First, he turns on the TV. Then, he takes his wife's e-reader and starts reading a cycling book. He starts reading a paragraph about cycling history. This paragraph is annotated with extra TV content, which sends an event to the book's server. The server logic processes the event sent, and pushes a video fragment in high-definition quality to Peter's TV. The fragment automatically starts playing. Later on, Peter comes across a section about a radio report on the \emph{Tour de France 1974}. His TV reacts automatically by playing the audio report.

The next day, Emma takes a field trip to a historic Indian site with her class. All the children get an e-reader in their hands to walk around with. She opens the textbook about the site and points the camera embedded in the e-reader at places she finds interesting. The camera is used to film the environment, which is shown in the book. Automatically, the book recognizes what is filmed, retrieves data from several sources and combines it into a page about the place. The significant elements in the filmed image are indicated and enriched with a small description (augmented reality). When she taps one of the indications, a page is formed with extra information about the chosen element.

Chapter 3: The family discovers e-reading security

Emma decides to take the tablet for reading a nice children's book. Her parents gave her a monthly allowance for e-books, so she goes to the online bookstore to find one she likes. The book she chose was intended for 16 year olds, so certain pages are not appropriate for someone her age. Luckily, the unsuitable paragraphs are annotated with parental control metadata. Instead of blocking the whole book, the content is modified, based on these annotations, so Emma can read them safely.

Chapter 4: The family discovers social reading

When Marc wants to read another comic book, he opens his reading app. There he can see the activities of his comic book club and what his friends suggest. Every member comments on books, pages or even certain scenes. Marc chooses a new Batman comic, which is suggested by the application based on his personal profile and the choices of his friends. While reading the comic, he adds his findings to the illustrations and links them to related stories, all for his friends to read. He is able to directly share his favourite one-liners on Twitter, or even alter the text of some panels, and share them on the publisher's Facebook page.

Isabel likes to get in touch with writers and asks them questions. She opens up her recently finished novel, and turns on the writer's perspective view. The book gets enriched with findings of the author by placing comments at certain paragraphs. When clicking a comment, she can read the follow-up questions by other readers and the author's answer to them. There's a passage she has a question about, so she selects it and attaches her question to it, hoping she'll get an answer soon.

Epilogue: the discussion

While the interactive, enriched experience of the Scott family is not readily available today, the recent advances in digital publishing and Semantic Web technology allow this to become a reality in the near future. As the amount and diversity of e-readers and devices continues to increase, we also see a more widespread support for Open Web standards, such as HTML5 and ePub3. Use of these standards allows for easy integration of all the features that add extra value to the reading experience, including enriched content, personalization, accessibility, security and social connectivity.

Enriching the content of a textual document is made possible thanks to the advances in Natural Language Processing tools and semantic taggers, such as OpenCalais and DBpedia Spotlight. These tools do not only accurately detect Named Entities from plain text, they also link these entities to resources in the Linked Open Data cloud, unlocking access to various sources of information.

Improving the machine-understandability of e-books gives way to new levels of personalized content, recommendations and security. Semantic annotations at the content level, using RDFa, enable a much finer-grained adaptation of the content to users. This includes modifying, restricting or adding content, depending on the use case.

Now that the technology is all there, what we need is an integration of all these features. Advanced authoring tools are needed, enabling fine-grained annotations, automatically suggested by Semantic Web agents and efficiently added by authors who are willing to go the extra mile. So essentially, the e-book of the future starts with the authors of the future.